PRELIMINARY NOTES ON SOME IGNEOUS ROCKS OF JAPAN. I[1]

S. KÔZU
Imperial Geological Survey of Japan

I. SODA-TRACHYTE

Localities.—Matsu-shima and Kakara-jima, two islets, six and a half kilometers northwest of the port of Yobuko, prov. Hizen, Kyûshû.

Occurrence.—As compact lava, associated with an alkaline feldspar-bearing basaltic rock.

Age.—Probably near the close of the Tertiary.

The following notes on the mineralogical and chemical characters were made from the specimen collected from Matsu-shima.

Megascopic characters.—The rock is blackish gray in color with semiwaxy luster, and by weathering easily changes to light brownish-gray with greenish tinge. The phenocrysts are of abundant feldspar, and are not easily distinguishable at a glance on fresh fracture surfaces, as their color is not white, but on weathered surfaces exposed to the washing of sea waves the minerals, being less attacked than the matrix, are as well marked as the coarse grains of quartz in weathered sandstone. The mode of weathering is a characteristic feature which enables us to distinguish the present rock from other rocks of the environs. The feldspar phenocrysts are thick tabular or sometimes stout prismatic, from 2 to 5 mm. in length, in rare instances 10 mm., and very light bluish-gray in color, for they contain abundant inclusions. The luster is not purely vitreous but slightly waxy. The groundmass is aphanitic and deep gray with light greenish tinge when freshly fractured, but the color soon changes from dark brownish-gray to light gray by weathering.

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Microscopical characters.—The phenocrysts are of abundant euhedral, or sometimes subhedral, feldspar. Almost all of them are of anorthoclase, in which a small quantity of plagioclase is present, either as nucleus of zoning which can be seen very rarely, as perthite composing the faint perthitic structure, or as local patches in the anorthoclase crystals. The groundmass is holocrystalline, though small amounts of brown glass are locally present in the vicinity of feldspar phenocrysts. It consists essentially of prismoids of alkaline feldspar, elongated toward the axis *a*. They are arranged as in typical trachytic fabric. A smaller quantity of thin and long prismoids of aegirine-augite, crystals or grains of magnetite, and slender needles of apatite are disseminated through the feldspathic groundmass.

Feldspar, as phenocrysts, is soda-microcline, containing anorthite molecules, that is, calcium-bearing anorthoclase. The shape generally shows euhedral form, principally bounded by crystallographic faces (001), (010), and ($\bar{2}$01), and is thick tabular parallel to (010), or is very stout prismoid, or cuboidal. The characteristic habit is derived from its appearing in a rectangular form on the face (010), owing to the domination of the planes (001), ($\bar{2}$01), and (010), as is the case with feldspar in "Rectangelporphyre," described by Th. Kjerulf. The well-known rhombic form is entirely absent. Parting parallel to (100) is so distinct that the cleavage pieces are very difficult to get, the crystal easily breaking into pieces along that face, as seen in Figs. 1 and 2. The twinning according to the Carlsbad law is the most common, very rarely the Manebach type is megascopically recognizable. Two other types (albite and pericline) appear faintly between crossed nicols; sometimes they are locally and irregularly distributed in the inner part of the phenocrysts. In some crystals microperthitic and microline structure are visible. Zonal structure is not uncommon, but is not so distinct as in the case of plagioclase. The outer zone usually shows a slightly lower refraction than that of the inner part, but both are lower than balsam. In one instance, plagioclase appears as a nucleus in the alkaline feldspar. Aegirine-augite and greenish-brown glass are comparatively abundant as inclusions; besides these, apatite needles and magnetite grains are usually inclosed

in small amounts. The mean index of refraction of the mineral measured by Wright's is $n_D = 1.526 - 1.531$. The extinction angle on (010) is $+5°$ to $+9°$, and on (001) 0 to $+1°$. The characteristic undulatory extinction is well marked. The plane of the optic axes is approximately perpendicular to (010), and the negative acute bisectrix is nearly normal to $(\bar{2}01)$. The apparent optical angle measured on the section nearly parallel to $(\bar{2}01)$, by Mallard-Becke's method, is $84° 44'$ and $2V$ is $52° 20'$, the mean index of refraction being assumed as $n_D = 1.528$. The dispersion is $\rho > \nu$.

FIG. 1

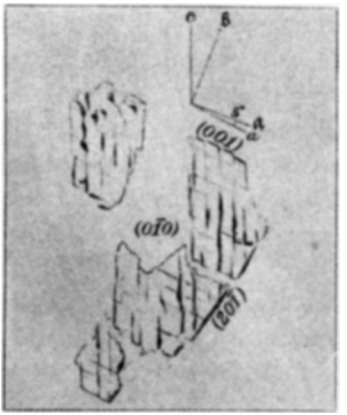

FIG. 2

The groundmass feldspars are also alkaline feldspar and occur in elongated prisms, simple Carlsbad twinning being commonly present. They are arranged as in trachytic fabric and the fluxion is especially marked around the phenocrysts.

Aegirine-augite, as phenocrysts, is almost absent, and the largest crystal, which was observed in 5 thin sections, measures 1.5 mm. in length, but the average length of the prisms is 0.2 mm. The mineral is of bluish-green color, and is somewhat pleochroic from bluish-green to the same color with yellowish tint. The greatest extinction angle measured with respect to the c axis, gave $45°$. As inclusions magnetic grains are common; and brown glass, appatite needles, and feldspar laths can be detatched, the last being very scarce.

Olivine occurs in some specimens, as a very rare accessory in an anhedral form.

Magnetite is very scarce as phenocrysts. Minute euhedral to anhedral crystals are disseminated in the groundmass, and form about 4 per cent of the whole. It is also associated with the aegirine-augite.

Apatite is conspicuous as very minute needle-shaped crystals.

Chemical characters.—Separate analyses were made of the rock and of the porphyritic anorthoclase.

For the purpose of analysis of the mineral, the phenocrysts were picked out of the weathered rock, in which the minerals remain on the surface in a favorable state to be taken off from the matrix. The feldspar material is quite fresh, but the surface and the inner portions along the parting and cracks are stained by decomposed products from the matrix and inclusions. To purify it as much as possible, it was crushed into 1–2 mm. grains and was digested in dilute hydrochloric acid at 80° C. for 24 hours, until it turned white in appearance. But an intimate association with impurities rendered it impossible to prepare a thoroughly clean sample, so that the results of analysis are somewhat unsatisfactory. The chemical analysis, made by S. Kawamura in the laboratory of the Imperial Geological Survey of Japan, is as follows:

SiO_2	64.98
Al_2O_3	19.62
Fe_2O_3	0.98
MgO	0.22
CaO	3.48
Na_2O	4.86
K_2O	5.83
	99.93

By the withdrawal of the excess of silica, lime, magnesia, and iron as impurities mainly due to inclusions, the chemical composition of the mineral is shown approximately by the following ratios:

SiO_2	63.08
Al_2O_3	21.80
CaO	3.24
Na_2O	5.39
K_2O	6.49
	100.00

From these figures the formula of the anorthoclase is found to be $Or_{2.38}Ab_3An_1$.

The analysis of the rock, by K. Takayanagi, and that of the pantelleritic trachyte, by Förnstner, are given in the following table:

	A	B
SiO_2	62.36	61.43
Al_2O_3	17.95	17.51
Fe_2O_3	1.55	5.11
FeO	2.62	2.30
MgO	0.72	0.54
CaO	2.75	2.45
Na_2O	5.60	6.22
K_2O	4.16	3.95
H_2O*	0.87	....
TiO_2	0.66	....
P_2O_5	0.29	....
MnO	0.48	....
	100.10	99.51

* Loss on ignition.

A = Soda-trachyte, Matsu-shima, Kyûshû.

B = Augite-andesite (pantelleritic trachyte of Rosenbusch), Porto Scauri, Pantelleria.

The norms, calculated from these analyses, are as follows:

	A	B
Quartz	6.1	5.0
Orthoclase	25.0	23.4
Albite	47.2	52.4
Anorthite	11.4	8.1
Diopside	0.7	3.3
Hypersthene	4.6	....
Magnetite	2.3	7.4
Ilmenite	1.4	....
Apatite	0.6	....
	99.3	99.6

Ratios from the norms are given below:

	A	B
$\frac{Sal}{Fem}$ =	9.25	8.31
$\frac{Q}{F}$ =	0.07	0.06
$\frac{K_2O'+Na_2O'}{CaO'}$ =	3.29	4.90
$\frac{K_2O'}{Na_2O'}$ =	0.50	0.42

In the quantitative system, the rock from Matsu-shima would be classified under the name of laurvikose, near pulaskose. There is a close resemblance in chemical characters between this rock and the pantelleritic trachyte which was described by Förnstner as augite-andesite, and is also laurvikose. The relationship between them is shown in the above tables.